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Real-Time Object Detection and Tracking from a webcam with OpenCV in Python

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ABSTRACT: With the assistance of a modified camera, real-time continuous monitoring of the response area is possible. Real-time object recognition and tracking is a rapidly expanding computer vision technique with promising future potential. In this research, the author employs the open-source library OpenCV (Open Source Computer Vision Library), which is primarily intended for real-time computer vision. OpenCV focuses on image processing and analysis in particular, such as object identification, face detection, and so on. Using computer vision, machines are taught to identify, understand, and interpret extremely complex visual information. Some of its subfields include scene modelling, object identification, position and motion estimates, video tracking, object segmentation, and image restoration. Many time-consuming operations may now be completed swiftly and smoothly without errors thanks to the real-time object tracking approach. The author of this work described identifying and tracking an item. The author also provides the methodology for object tracking via a camera and discusses its limitations as well as uses.

***Keywords** – real-time computer vision, image processing, and tracking*

1. INTRODUCTION

Object recognition and tracking have emerged as one of the hottest topics in computer vision in recent years, with many academics racing to create the best object detection and tracking method. Several machine learning (ML) and deep learning (DL) models are used to improve performance in the process of object recognition and related tasks. The basic concept behind real-time is to extract features from an image or video frame. The main premise is to find the difference between the current frame and the reference frame (also known as a "background picture" or "background pattern") and use it to identify moving objects.

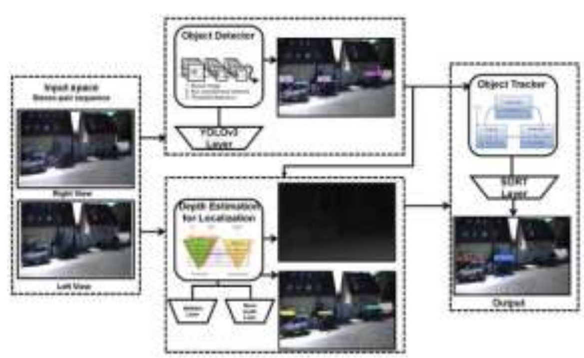

Fig.1: Example figure

There are various methods. Background subtraction and the Principal Component Pursuit (PCP) methods are essential. It depicts the item of interest since object modelling is performed by eliminating the qualities that accurately characterise a target. The object is then monitored using these attributes. A feature is an image style that distinguishes a certain item from its surrounds, and these traits are subsequently processed into the specifications desired by the appearance features. PCA-based approaches for video processing have lately proved their supremacy and lightning-fast performance. In addition to the design of algorithms, the object identification process is based on deep learning. While each of the aforementioned tactics has several advantages, they might sometimes fall short in certain situations.

2. LITERATURE REVIEW

Robust object tracking with online multiple instance learning [14]:

Here examine the challenge of tracking an item in a movie given its position in the first frame and no additional information in this work. A family of tracking methods known as "tracking by detection" has recently been proven to provide promising outcomes at real-time rates. These approaches use an online discriminative classifier to isolate the item from the background. This classifier bootstraps itself by extracting positive and negative examples from the current frame using the current tracker state. Slight tracker mistakes might therefore result in wrongly classified training samples, degrading the classifier and causing drift. Authors demonstrate in this study that employing Multiple Instance Learning (MIL) instead of standard supervised learning overcomes these issues, resulting in a more robust tracker with fewer parameter modifications. They provide a unique online MIL method for object tracking that produces improved results while operating in real-time. They give comprehensive experimental findings (both qualitative and quantitative) on a variety of difficult video snippets.

A review and comparison of measures for automatic video surveillance systems [15]:

Video content analysis is rapidly being used in video surveillance systems for a wide range of applications. However, the dependability and durability of video content analysis algorithms continue to be a concern. To assess the performance and improvements of new algorithms, they must be compared against ground truth data. As a result, several measures have been presented in the literature, but there has yet to be a comprehensive review or assessment of metrics for particular video analysis tasks. This work does a thorough assessment of metrics and evaluates their efficacy in particular areas such as segmentation, tracking, and event detection. Details such as normalisation difficulties, robustness, and representatives are highlighted. A software framework for continually analysing and documenting the performance of video surveillance systems is provided. A new set of representative measures is offered as a vital aspect of an assessment framework based on many years of experience.

Handcrafted and Deep Trackers: Recent Visual Object Tracking Approaches and Trends [18]:

Visual object tracking has been a highly active study subject in recent years. Each year, a growing number of tracking algorithms are presented. This is due to the fact that tracking has several applications in real-world challenges such as human-computer interaction, autonomous cars, robotics, surveillance, and security, to mention a few. In this paper, the authors analyse recent trends and developments in tracking and assess the robustness of several trackers based on feature extraction approaches. The first section of this paper is a thorough examination of the newly suggested trackers. Trackers are divided into two types: Correlation Filter based Trackers (CFTs) and Non-CFTs. Based on the design and tracking system, each category is further categorised into numerous categories. In the second section, we tested the robustness of 24 contemporary trackers and contrasted handmade and deep feature based trackers. They found that trackers with deep features performed better, however a combination of both improved performance dramatically in several circumstances. To address the shortcomings of the current benchmarks, a new benchmark Object Tracking and Temple Color (OTTC) has been created and is being utilised in the assessment of several methods. Authors examine tracker performance in eleven distinct OTTC tasks as well as three additional benchmarks. Their research reveals that trackers based on Discriminative Correlation Filters (DCF) outperform the others. This research also shows that incorporating various forms of regularisations over DCF typically leads to improve tracking performance. Finally, They summarise their research by highlighting some key findings and forecasting future developments in the area of visual object tracking.

3. METHODOLOGY

The author focused on developing software to recognise real-time objects and track them within the range of a web camera, and then track the item using a laptop's built-in webcam. The author utilised Python 3.11.1 and the PyCharm IDE. The first step is to install the "OpenCV-python" and NumPy packages. Using the "VideoCapture" class, you may record video from your laptop's built-in camera.

Background subtraction is the technique of constructing a foreground mask—specifically, a binary image consisting of the pixels belonging to moving objects in the scene—using static cameras (BS). BS generates the foreground mask by removing the current frame from a background model that includes the static section of the picture—or, more broadly, anything that may be considered background has given the properties of the observed scene.

Fig.2: System architecture

Object Detection:

Object detection is a method that is frequently used in image processing, computer vision, and deep learning to recognise and track objects in movies and pictures. The two fundamental components of object detection inside an image with a sufficient degree of certainty are differentiation and recognition.

Object detection differentiation may be defined as recognising all items in a picture. This is further subdivided into two parts: classification and tagging. Tagging may identify many item classes for a given picture, while classification can only identify one. Recognization refers to the filtering of the attention-seeking item. There are two approaches to this: segmentation and detection. Detection generates the bounding box or rectangle that identifies the position of the elements. Although it is a generally dependable technology, it is not without error or inaccuracy. Segmentation, on the other hand, provides an exceptionally precise map by identifying the objects for each pixel in the image. To achieve segmentation accuracy, however, a comprehensive and often time-consuming neural network training procedure is required.

Object Tracking:

One such computer application is Object tracking is the detection of an object in a video, which is otherwise described as a series of frames, and the calculation of its trajectory. As an example, Assume you have a tape of a cricket match and need to continually track the movement of the ball. Object tracking enables real-time monitoring of its appearance across the screen by anticipating the trajectory of the ball. These are classified into two types: SOT (Single Object Tracker) and MOT (Multi-Object Tracker) (Multiple Object Tracker). The method of keeping track of just one distinct item throughout a film or sequence of frames is known as single object tracking. Similar to SOT, Many Object Tracking includes tracking multiple things at the same time inside the same frame or film. The MOT is significantly more intricate and difficult than the previous one.

4. EXPERIMENTAL RESULTS

The result seems to be functioning in the machine's built-in camera. The application does not need a powerful computer to operate. The border-box is used to distinguish between the primary item. The backdrop item is also performing nicely. However, there seem to be certain downsides to this undertaking.

Fig.3: image detection

5. LIMITATIONS

a. Gathering of multiple objects: When numerous objects are so close to one another, the computer may be tricked into thinking they are one and the same thing, or it may simply misidentify the item.

b. Real-time Speed: The algorithms must be utilised to rapidly and correctly find the subject in a video. This detection time might be substantially affected accidentally due to the vast variety of background disturbances in each setting.

c. Limitation of data: It has a severe problem with the tiny quantity of datasets. Despite several data collection efforts, detection datasets continue to be significantly less in breadth and frequency than picture classification datasets.

d. Aspect ratios and sizes: The items' aspect ratios and sizes vary. As a consequence, the detection algorithms must be capable of distinguishing unique objects from varied perspectives and sizes, which may be difficult to do.

e. Changes in light: Different types of lighting may lead the item to exhibit different colours, resulting in the object being less light than it is. This may have an impact on the detector's efficiency.

6. CONCLUSION

The purpose of computer vision is to automate machine operations that can be performed by human vision. Computer vision allows robots to do activities traditionally performed by human sight and cognition by using cameras and algorithms rather than nerves and retinas. This technique has several uses in security and business. The object-detecting approach is employed in the development of complicated and advanced robotics.

7. FUTURE WORK

Future research should concentrate on creating an accurate understanding of different algorithms in order to decrease tracking errors and use the optimum method to cut the time required to track objects. Object tracking is a thriving industrial technology with a promising future due to its many uses. The author recommends some of the apps.

• Object detection is an excellent way for monitoring activity both inside and outside of a mall. It may also count the number of people that pass by or stop outside the company. With all of this data, merchants can better understand the busiest shopping times and modify their operations to attract more people. The owner may watch each movement inside the firm to determine the optimal traffic flow. This makes product placement and marketing simpler to organise, and it indicates any areas of the store that need to be redeveloped.

• Computer vision is critical in autonomous cars. Object identification systems, such as signs, pedestrians, stop lights, lane markings, and other vehicles, are critical.

• Object detection has a variety of uses in security and safety. The CV may be deployed on surveillance systems to continually search for security hazards in locations like airports and transportation networks.

REFERENCES

1. Balaji, S. R., and S. Karthikeyan. "A survey on moving object tracking using image processing." In *2017 11th international conference on intelligent systems and control (ISCO)*, pp. 469-474. IEEE, 2017.
2. Han, M., Sethi, A., Hua, W. and Gong, Y., 2004, October. A detection-based multiple object tracking method. In *2004 International Conference on Image Processing, 2004. ICIP'04.* (Vol. 5, pp. 3065-3068). IEEE.
3. Janku, P., Koplik, K., Dulik, T. and Szabo, I., 2016. Comparison of tracking algorithms implemented in OpenCV. In *MATEC Web of Conferences* (Vol. 76, p. 04031). EDP Sciences.
4. Culjak, I., Abram, D., Pribanic, T., Dzapo, H. and Cifrek, M., 2012, May. A brief introduction to OpenCV. In *2012 proceedings of the 35th international convention MIPRO* (pp. 1725-1730). IEEE.

5. Singh, S.P., 2021. Comparing various tracking algorithms in opencv. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *12*(6), pp.5193-5198.
6. Saxena, M.R., Pathak, A., Singh, A.P. and Shukla, I., 2019. Real-time object detection using machine learning and opencv. *Int J Inform Sci Appl (IJISA)*, *11*(1), pp.0974-225.
7. Pulli, K., Baksheev, A., Kornyakov, K. and Eruhimov, V., 2012. Real-time computer vision with OpenCV. *Communications of the ACM*, *55*(6), pp.61-69.
8. Lei, Z., Xue-fei, Z. and Yin-ping, L., 2008, December. Research of the real-time detection of traffic flow based on OpenCV. In *2008 International Conference on Computer Science and Software Engineering* (Vol. 2, pp. 870-873). IEEE.
9. Papageorgiou, C.P., Oren, M. and Poggio, T., 1998, January. A general framework for object detection. In *Sixth International Conference on Computer Vision (IEEE Cat. No. 98CH36271)* (pp. 555-562). IEEE.
10. Rejuwan S., Md. Arshad, Dr. v. pandey., 2022, October. A Machine Learning Model to Protect Privacy Using Federal Learning with Homomorphy Encryption. In International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 10 Issue X. DOI:10.22214/ijraset.2022.47120
11. Machine Learning's Algorithm Profoundly Impacts Predicting the Share Market Stock's Price - Rejuwan Shamim - IJFMR Volume 4, Issue 5, September-October 2022. DOI10.36948/ijfmr.2022.v04i05.911
12. Zou, Z., Shi, Z., Guo, Y. and Ye, J., 2019. Object detection in 20 years: A survey. *arXiv preprint arXiv:1905.05055*.
13. Tan, M., Pang, R. and Le, Q.V., 2020. Efficientdet: Scalable and efficient object detection. In *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition* (pp. 10781-10790).
14. Babenko, B., Yang, M., Belongie, S.: Robust object tracking with online multiple Instance learning. EEE Transactions on Pattern Analysis and Machine Intelligence 33(8), 1619– 1632 (2011) 2
15. Baumann, A., Boltz, M., Ebling, J., Koenig, M., Loos, H.S., Merkel, M., Niem, W., Warzelhan, J.K., Yu, J.: A review and comparison of measures for automatic video surveillance systems. EURASIP Journal on mage and Video Processing 2008(824726), 1–30 (2008) 2
16. Bhat, G., Johnander, J., Danelljan, M., Shahbaz Khan, F., Felsberg, M.: Unveiling the power of deep tracking. n: Proceedings of the European Conference on Computer Vision (ECCV), pp. 483–498 (2018) 13
17. Cehovin, L., Leonardis, A., Kristan, M.: Visual object trac ˇ king performance measures revisited. EEE Transactions on mage Processing 25(3), 1261–1274 (2016) 2
18. Fiaz, M., Mahmood, A., Javed, S., Jung, S.K.: Handcrafted and deep trackers: Recent visual object tracking approaches and trends. ACM Computing Surveys (CSUR) 52(2), 43 (2019) 1
19. Henriques, J.F., Caseiro, R., Martins, P., Batista, J.: High-speed tracking with kernelized correlation filters. EEE transactions on pattern analysis and machine ntelligence 37(3), 583–596 (2014) 13

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20. Henriques, J.F., Caseiro, R., Martins, P., Batista, J.: High-speed tracking with kernelized correlation filters. EEE Transactions on Pattern Analysis and Machine ntelligence 37(3), 583–596 (2015) 2